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DDT FOR CODLING MOTH CONTROL

DDT has been found more effective against the codling moth than other materials now in use. This conclusion has resulted from three years of field tests at Vincennes, Ind., and two years of such tests at Yakima, Wash., Kearneysville, W. Va., and Poughkeepsie, N. Y., supplemented by large-scale orchard tests in cooperation with growers in Indiana in 1944 and in Missouri, Indiana, Kentucky, West Virginia, and New York in 1945, against light and severe infestations and under a wide range of climatic conditions.

Although DDT is extremely effective in codling moth control, certain unsolved problems connected with its use make unqualified recommendations impossible at this time. These problems, discussed in more detail later, include the tremendous increases in the populations of mites and certain other insect pests that often follow the use of DDT, the effect of DDT on beneficial insects, the residues that may occur at harvest time on fruit sprayed with DDT and the removal of any excessive residues, and possible undesirable accumulations of this material in the soil.

Although solutions are not yet available for certain of the problems involved in the use of DDT for the spraying of apple, it is recognized that many growers, especially those who have experienced serious worm damage to their fruit in recent years, plan to use it in 1946. Growers who have been controlling the codling moth satisfactorily with lead arsenate or other standard material would do well to postpone using DDT for at least another season or restrict its use to experimental applications on only a portion of their acreage. For the benefit of growers who plan to use DDT, available information about its use for the purpose is here summarized.

DDT will probably be used more extensively in the East and Middle West than in the Northwest, where orchard mites are unusually abundant and destructive, where the woolly apple aphid is particularly serious, and where greater spray residues seem to develop from spraying with DDT. The following suggestions therefore relate primarily to orchards in the East and Middle West.

Since technical DDT does not mix readily with water, processed formulations must be used. For general orchard work, water dispersible powders containing from 25 to 50 percent DDT appear to be most suitable. The higher strength is preferable wherever visible residues are likely to be a problem. The DDT should be secured from reputable concerns or their agents and should be preparations of proved merit. The use of untried products should be avoided.

The DDT program could well start with the first cover spray, in which case all of the applications normally made prior to that time should be put on as usual. Where the European red mite is a major factor, the usual dormant or delayed dormant sprays should be applied. Although these sprays may not keep the mites from increasing to destructive numbers, such increases will be considerably delayed. If plum curculio is serious, lead arsenate should be added to the first cover spray.

Three or four first-brood covers of DDT at  $\frac{3}{4}$  pound to 1 pound per 100 gallons, and one or two later ones at  $\frac{3}{4}$  pound should give a highly satisfactory degree of control of the codling moth if thoroughly and timely applied. The first application should be put on just before the first eggs are expected to hatch, and subsequent applications should follow at intervals of 10 to 14 days during the period of first-brood activity and when activity by later broods of worms shows signs of increasing. The final application should go on at least a month before harvest. Oil should not be used with any but the earliest applications.

In many areas low strengths of DDT (4 to 6 ounces per 100 gallons) have been used successfully with standard codling moth insecticides at about half strength. In many cases lead arsenate has been used in this manner with very satisfactory results. In other localities half-strength nicotine bentonite, either processed or tank-mixed, has been used in the same way. Split-season schedules, with one mixture used against the first brood and another against the second, have also been used effectively.

DDT is reasonably compatible with most fungicides, and can be combined with them whenever the control of diseases requires their use. In addition to the objections, from the standpoint of residues and of foliage injury and fruit drop, to the use of oil with DDT, some oil emulsions cause the DDT to separate out from some formulations and form putty-like or greasy masses. The results as to the use of lime with DDT seem conflicting, and no general conclusion has yet been reached.

Because of the factors already mentioned the use of DDT in the Northwest should be guarded especially carefully until more effective programs for controlling orchard mites are developed, until more is known of the status of the woolly aphid following its use, and until residue removal methods have been developed. If used in that area it should be included in not more than two applications at  $\frac{1}{2}$  pound per 100 gallons, at or near the period of peak first-brood moth activity.

Some of the unsolved problems resulting from the use of DDT will be discussed briefly. Apparently because of the fatal effect of DDT on certain predators and parasites, certain orchard pests, not affected by DDT at ordinary strengths, often suddenly become extremely abundant when DDT is used in the orchard. The most serious problem has been the increase

in orchard mite or red spider populations to destructive numbers, often leaving the trees partially defoliated and the remaining leaves more or less brown and dry late in the summer. No definite recommendation can be made for the control of these mites or red spiders in orchards sprayed with DDT. Certain "dinitro" compounds have been used successfully in some localities, but severe foliage injury has been reported elsewhere. The Jonathan variety is especially susceptible to injury by the dinitro compounds. Summer oils are of considerable value in mite control, but may increase DDT spray residues or cause injury. Mixtures of xanthone and DDT offer some promise, and are being explored further.

Many DDT programs may cause harvest residues in excess of the tentative administrative tolerance of seven parts per million (about 0.05 grain per pound of fruit). Since no reduction of DDT residues by brushing the fruit has been found possible, and only a slight reduction has usually been effected by the various washing treatments tested, it is necessary that the DDT programs used be reasonably certain not to leave a harvest residue in excess of seven parts per million. Since many factors affect the size of the harvest residues that may result from the use of any given program, it is not yet possible to state just how much DDT can be used without exceeding the tolerance; neither can it be stated just when the last application should be made with respect to harvest nor just how much oil or other sticker can be used with it and when. However, such analyses as are now available indicate that under eastern and middle-western conditions the use of DDT in six covers at the rate of 1 pound per 100 gallons in those applied against first brood and 3/4 pound in those applied against the second brood, without oil, and with the final application a month or so before harvest, results in residues of approximately the present tolerance. When used with oil, DDT in excess of 6 ounces per 100 gallons in six applications during the season usually results in residues greater than seven parts per million. In addition, use of oil alone late in the season over heavy DDT residues resulting from earlier applications may also result in excessive DDT residues at harvest. In the Northwest the residues resulting from comparable programs seem considerably higher than in the East or Middle West.

Little is known as yet regarding the rate at which DDT may accumulate in the soil as a result of its use in sprays, of its fate therein, or of the effect of possible accumulation of it on the trees or other crops, including cover crops, that may be present. Under certain conditions, 25 pounds or more of technical DDT per acre has affected the growth and productivity of a few vegetables and other plants when mixed intimately with the upper few inches of soil.

The suggestions made herein are of necessity very general. More detailed information may be obtained from State experiment stations or extension services or from county agricultural agents.





